Notebook, N-00-01-23

This notebook covers the periods January and August 1900. At the beginning of the book are notes from January 1900 by an unidentified experimenter regarding magnetic iron ore separation and cement experiments [not selected]. The remainder of the book contains notes and cost calculations from August 1900, primarily by Edison, in regard to storage batteries. Included are entries recording Edison's early tests with copper and zinc electrodes. There is also one entry on copper ore separation. The front cover is labeled "Started Aug 6th 1900 (1)." The pages are unnumbered, and at least one page has been removed from the book. Approximately 120 pages have been used.

Aug 6 1900 TAE

Experiments with Storage Battery

Copper Zn – NaOH =

Experiments so far all indicate that the production of the dark blue Copper salt in the NaOH is due to lack of ~~[illegible]~~ sensitiveness of Copper to oxidation, ~~or etc~~

When the Copper is finely divided and not dense it oxidizes easily & no blue salt is formed but if dense it quickly forms also forms when the Current is so strong that there is free gas (O?) O. apparently the salt is the product of the action of O on Oxide of Copper & may be a peroxide which would be acidic & combine with NaOH & be soluble –

The Cu scale silvered over gives blue & it occurred to me that Copper reduced by Zinc would be very sensitive so I got some & silvered it by Ag Cy KCy – ~~[illegible]~~ using 10 grams Copper + 1 gram Nitrate silver (dissolved & put in the KCy)

This grid in 20% NaOH gave 50% effect & did not give any blue that could be seen

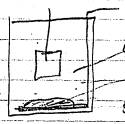
3.5

7

Evidently the silver gave contact with grid after oxidation & the Copper being very fine was very sensitive to OxDiz of grid and reducing it to see if it won't give a higher efficiency on 2nd charge.
Ratio on reducing the liquid has an extremely faint green tinge — also Ni grid has a yellow or purple tint outside coloring to Copper. The platina wire on oxidizing & reducing to clean Bin trying to coat reduced flower Copper with Nickel by electroplating method of silver.

Reducing .62 at 10.32 AM — 1 hour off for dinner grid gassing along at 5 pm
Reversed at 5 pm to Oxidizing — grid got very dark when gassing — .6 amperes on
The black may be silver or Cop but if Cop it ought to be yellow.
Sol not blue or green though it may have a slight tinge. Is not Water white at

We are trying to deposit Nickel on Copper precipitated by Zinc



It dont seem to plate although have been on 20 minutes think it wants time — May be that it must be deoxydized before it will plate as Cop prep is probably oxdzd slightly =

at 6 pm the grid had not cleaned
was still dark brown
at 6.05, ·64 - put it back to 1.6

at 8.05 I filtered solution, it came through a pretty
without appreciable tint —
pt Electrode had considerable
black stuff on, hard to come
off when running through finger
Solution was tinged by particles
floating, 8,15 put Solution
back to work —
Electrode is getting lead brown
cleaning up —
I found in glass considerable
Copper fall out grid, about as
much as on tip of knife blade
it quiet some, dont know why,
Expect to renew part of cold Zinc
Solution in grid —
quick grid to clean
Lays deposit on Plat, think
its Zinc - Solution water white

Commenced to gas at 10 20,
making 5 Hours & 15 minutes
average of ·62 or 3.25 amp hours
to oxidize at a lower density say ·2
it might have run one hour more
but that would only bring it to
3.45 amp —

10 20 Reversed & now reduce
·6
grid unlike last time when
I allowed it to gas hard is not
Colored, Solution W White —

at 12 midnight put it at
·3

Started gassing 9 am - 2.8
amp hours — This is because
I didnt fully oxidize it —

Reversed to oxidize at 9 am —
·6
Took staff —

6 hr
3.70

1 — 2.11

1.40

0

We plated some Cu sponge with Nickel there was about 3 grms & had about 3 amp hours on it. its black. Wt of grid 5.6 with Cu Ni on it 8.85 leaving 3.25 grms but there is probably 5 to 6 % water in grid.

On at 10.50 amp
.3
after 5 minutes no blue
50 minutes passed — .3 amp hour

Reversed at 1140. .3
passed at 12 — only 20 minutes gone —

further along

Copper.

#1. Is Concentrate of .012
Concentrated to 18 % Assays.

#2. Is Tailings of #1 Assays.

Divided at 13. Side dross on Tan
fuel oven.

#3. Is Concentrate of .007.
Concentrated to 12 % Assays 4.13

#4. Is Tailing of #3. Assays 2.11

Divided at 35. Side dross at 1.

#5. Is Concentrates of .009. Concentrated
to 15 %. Assays 4.79

#6 Is Tailings of #5 Assays .87

#7 Is Concentrate, of .012.
Concentrates to .18%. Assays.

#8 Is Tailings of #7 Assays.

Divides at 30. Tan door. 1½.

Have made a number of washing tests to show what percentage of Copper there is in the different fresh stuff. find that the larger amount is in stuff from #4 to #9. Screened down through 200 mesh. Screen and find quite a lot of Copper in it. How be this float will all have to be kept in practice, and treated afterwards.

Have you started to make separation of the different meshes. Could keep a bottle of the Concentrate & one of the tailings as samples.

Separation of .004 stuff was made with Resistance full on Shutter closed & fan closed. Divides at 25 & 45

used about 50% of course stuff along with fine. Made it fast enough.

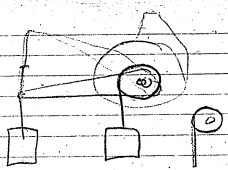
Separation of .007 stuff was made with 17 bars of Resistance in Fan door open 1/2. Divides at 25 & 40.

Separation of .009 stuff was made with 17 bars Resistance in Fan door open 1 1/2" Divides at 45. Did not use any course stuff with this sign.

Separation of .012 stuff made with 9 Bars Resistance in Fan door at 3. Divides at 45.

Separation of .015 made with Resistance in 5 Bars. Fan door open 4 1/2" Divides at 45.

63.



18	180
66	1312
151	1000
20	2000
12	1200
30	1600
297	8292

18
130
151
10
10
319
66
253 295

36

on 16
33
30
79

100

grid Expenses Continued
Aug 7. 1900

Have figured out roughly relative costs of Acid & Mercury battery for 6 Hp hours

Zinc	18	lbs	~~64~~ 136
Scale	66	"	66
Solution	151	"	50
Scalequid	20		33
Zincplate	12		70
Mercury	30		255
Sulphuric	1.3	lbs	
	297		
	295		

108
1300
100
1200
3600
60
63

66
25
13.3

lbs Zinc per HP hour	3.03
" 67% Copper Ox per HPH	5.50
" Silver 1 to 20 "	.22
" 25% Sol 85% Effy "	25.20

8½ lbs 25% Zinc Sol for 1 lb Zinc
85% plates cut.

required wt for 6 HPh with cell
2.65 lbs

Made a new grid - Cop by Zinc,
washed out Zinc mud as well as
possible, boiled Cop in 20% NaOH
then washed, Weighed out 12 gms
used 2 gms Nitrate Silver in KCy
Silvered Cop. about 25% of Ag dust
go in - powder beautifully coated
with silver, washed & tested. Wash
water for Ag by HCl, packed in
grid by ramming and bumbs

stick packed it in portions about 3/16 at once, rammed hard — only occupied less than 2/3 of grid — Soaked it in 20%, then waved it to get loose particles out — soak it — then put it in a 20% NaOH —

·6 at 2.15 —

Slight blue floated out top of grid in 5 minutes. This might be some Hydrate in it — Will change solution soon —

The CuAg packs when damp (after squeezing in handkerch.) beautifully

I have just waved electrode: Considerable blue — once of it continues to come out,

Should say roughly that the Copper had 1/10th of Silver added (1E)

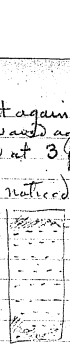
Copper 10 Silver 1.

In 5 minutes after waving blue appeared again at top of grid

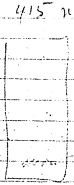
at water line

Waxed it again - at 3.55 came out very slow - waxed again - + put it in new Solution at 3 pm -

at 415 noticed a phenomenon



Solution 415 not blue but OR -



4.45 gassing a little,

454 pm grid darkening a little
Solution tinted very slight
greenish — possibly I have packed
grid too tight & left no porosity
the oxidizing solvent to wield pack it
tighter —

The Copper by Zinc is alotted together
it may be that I have it too wet
with wooden pestle to separate &
make very fine Cop — & that too
much silver closes the pores &
grid want stand such a heavy
current density — packing too tight
& too much silver is probably the
trouble —
The amount of gas 510 is quite small
closed day 85 the 90% washing
taken Cop of —
540 gassing about 20% @ 25 (
total) Spot on or two of grid
at bottom not much on anode
balance grid clean but little
browned Solution no more
tinted & content across it was
tinted at all as gas from

platinum Electrode clouds if so if tinted to a Silver Grey and tint 6.45 - purple tint - due to Silver undoubtedly - gassing 50%.

No 2 Cell Ni grid packed with Cop by Zinc - plain not CP + treated tried it stix together somewhat with HgCyK, packed firmly but not hard like Silver ~~and~~ Coated Cop in Ni grid (10) Cell No 1

On 6.45 .6 amp -
6.50 no blue -
at 7 pm "
8 pm decided blue

No 3 Cell is Ni grid plated with Silver + Cop by Zn with 1/20 Ag from Cyanide not packed tight about same as No 2
No 3 on at 7 pm .6 Amp
8 pm decided Blue

.6

Reversed No. 1 Cell at 8.10 pm —
3.6 amp hours but last hour
been going probably 85% —
brown spots on grid almost many
cleaned away —

8.10 pm grids of No 243 bright —

I am quite sure the bluing of No
243 cells is due to fact that
washing Cyanide Cop. out of
Copper powder + this was deposited
on grid as Cu hydrate when grid
dipped in Soda Solution. This
lack of Washing Chemicals out
of Sponge + Scale may account
for lots of blue in all our
previous exports —

8.40 Changed solution in No 1
Cell put fresh Soda Solution —

8 16 pm I change solution for fresh No 2 + 3 cell —

9 o'clock PM - no blue has appeared in No 2 + 3. This shows pretty sure that the blue was due to CuOH left in by failure to wash cyanide Cu out —

9 40 pm very slight tinge green in Nos 2 + 3. No 2 has the most, probably because most CyCu was in it from using large quantity KCy —

Nos 1 2 + 3 grids all bright — No 1 is reducing of course

No 4 = Cu sponge 20 grms moist, treated with 2 grms Nut Silver in KCy - washed then treated with Hgly KCy & well washed - but still there was a slight greenish opalescence on last wash water with Fe(CN) - used hot water (rinsed 3 or 4 times besides

1.20
2 40
3 6
1.

several times with cold water

No 4 on at 10.12 pm.
.6 amp—

at 11 pm no blue solution perfect,

At 11 pm. Changed to new solutions No 2 + 3 as they had become quite blue,

The Cu that went into No 4 grid shows scarcely any silver + Hg possibly KCy dissolved it off or Silver went away + only Hg stayed & probably used too much mercury so that Hg deposited + Ag dissolved off — This should be tried again with 2 grms Hg + 3 grms AgNO3 instead 2 grms to 20 of water Cop—

I now feel quite sure all our previous experiments showing blue is due to Cupric Hydroxide in Copper due to reagents used & failure to wash them out properly. Hereafter wash well with water cold then warm until test reagents shows wash water free of Copper salts.

11.15 pm No 2 gassing quite strong This is Hg alone & its probably that 60% is out of contact — No 2 is No — Mercury will not do I & for No 4. will see God as I think all the slurd is gone & Hg taken its place — 2.75 amp hours only & yet there must be 16 grms Cop in grid —

at 11 25. I imagine No 4 has an scheme, delicate test but doubtful —

No 5 is 20 grms Cu 3
grms Nitrate Silver + KCy
just sufficient to dissolve it
then diluted with 3 oz of
water + after washing
Cu 10 times in distilled
water to get rid Sulph Cop
added Silver solution
stirring all the time
Cu turned grey silvery —
then washed 4 times in
distilled water, then used
small quantity HgCy about
1/2 gram to guard with
smallest quantity KCy —
then diluted with 3 oz
water + stirred + put in
Copper beaker stirr one
minute then washed dozen
times in distilled water +
then hot water twice —
Ferro gave practically no
Copper —

Silver grid got perhaps
12 to 15 grains in —

No 5 on at 12 20 morning
·3 amp
I now cut out No 2 -
& put all on ·3
ampere for the night
at 12 20 AM —

No 4 has slight tint
blue - No 3 no blue
No 1 gassing strong
it is now reduced & at
1220 AM I reverse it
to oxidize grid

In the morning at 8.15

No 5 blush with very large amount of fluffy black stuff on platinum pole + some in bottom jar + some floating altogether enough to be of bulk of a cent

No 1 Blush Some fluff on + little dropped off platina

No 3 Very blue and gassing strong grid black. platina very little fluff fining but some fluff dropped down

No 5 Grid bright not gassing but platina wire 1/4 fluff + some dropped down also blush

Stopped Current on all at 8.20. — all platinas with fluff except No. 3 gas - showing Line or something as electro plating

3.10
2.6
1
4.1

2.40
2.00
1.6
3.1

No 4 has 3.6 amphours and yet gassing. this is best yet –

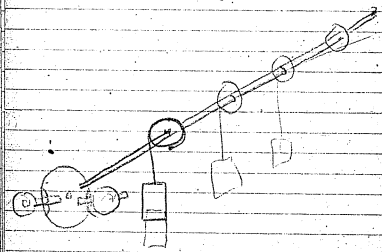
All on at 8.30. + put up to .6 amper –

at 9 o'clock AM. No 4 grid black – but not gassing – Can this be due to a higher density acting on Silver or is it due to fact Copper is getting out Contact soon will be gassing

At 9.10 Eat off fluff on all platinum – put all in new solution + platinized .6 at 9.15

As No 3 is gassing I now reverse to reduce grid –

Took lot of Cop R by Zinc that had been squeezed around all night, put it in water worked it fine with fingers washed 5 or 6 times then put in few drops H_2SO_4 - it brightened to ~~the~~ right away - showing there was lots Cuprous Ox on it. Then washed it some + put it in ~~about~~ 20% Soda, twice then washed but didnt get all soda out, Squeezed & then weighed 20 grms wet stuff squeeze stuff - put in beaker kneaded out lumps with fingers then washed twice then added 3 grms $AgNO_3$ KCy - in dilute and stirred it strongly while adding - Then allowed it to remain in Silvering solution 1/2 hour Then washed 5 or 6 times + soaked 15 minutes then squeezed + put in Silvered grid No 6 cell - Silver grid soaked all night in water + water changed + soaked 3 hours notice gas coming off as yesterday between Wt 4 aq for from previous experiment

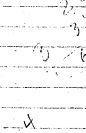


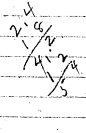
10.15 No 1 grid starting to gas 3.6 amp hours this is poor efficiency

at 1030 AM. No 5 Clear WW.
No 1 Rose shade of brown No 3 Clear – No 4, decided brown grid very black all over – Lampblack black –

If the silver coat on grid in No 4 gets black then the silver on the Copper must get black or oxidize. therefore it cant act as a Conductor

No 7 to Ni grid & Copper
Scale coated platinum by heat with double Chl Pt & Na neutral –
160 Fahr – On at 11 AM .6
Blue appears instantly at top





11 am No 1 is Silver pink. No 4. has silver pink & something else making it darker

11 10 am No 5 not blue yet,

No 4 Solution Changed at 11 15 AM. grid graying slightly —

1116 AM No 7 blue hint to cell —

No 6 Cell on at 11 35 .6

must have got 16 grms — grid —
No 6 has a slight blue — some doubt about grid note previous says silver —

No 7 Cell blue — graying at 11 45 AM —

No 6 at 1145 hint blue at top No 1 grid —

11.50 AM. No 5 Silver grid just started to blacken all over —

No 8 Cell is reg Cop sponge in water acidulated with little H_2SO_4 & then metallic Hg put in till it makes a powdery amalgam which stays together easily and pinching = & soak in Solution 10 minutes to permit soda get in —

On at 12 10 pm —

Current off 12 11 pm —

No 8. shows amalgam at holes on grid bright yellow

Current on at 1.05 pm — .55 amp

No 8 Blue dropping down from bottom of the grid in streaks Very strong none at the top —

Notice that No 4 is not giving can it be that solution must permeate to do the work the stop of 1 hour has permitted fresh solution to permeate — If this is so then this grids will be in order or several times put on grid & pocked & then withdrawn

Reversed 1.10 pm —

No 8 was with unwashed Cop & probably ~~to~~ impure —

1.25 No 8 giving —

Reverse it to Reduce at 1.25 pm

No 8 at 1.30 no more blue Coming off — No 8 started to give slightly at 1.35 —

It does seem that liquid circulation is essential, -

No 4 grid neighboring Sweetcell
Color is losing [illegible] by [illegible]
first,

9 reverse No 8 at 1,36 pm to
see if can't get Ni electrode
amalgamated

Reversed No 1 at 1,50 pm
to Reduce

Reversed No 7 to reduce
at 1,50 pm - Red

Reversed No 5 1,55 pm -
Redcy -

Reversed No 8 back to Oxdgg
2 pm —

No 6 & No 8 at 2 pm
fresh Cells —

No 9 is ord Cop only
slightly colored a while
was washed squeezing out
in grid not packed
to give porosity No grid
on 2:15 pm 6
9 put it in Reducing at
first to reduce any CuOH
~~[illegible]~~

It starts gassing in 1 minute
~~will keep it on 10 minutes~~
~~then start O2 gas~~ gas.
Commenced to start stuff out
of grid - let it gas 15 seconds
then started O2 2.20 pm

No 6 Dont blow at 2.20 pm

No 8 - Blue streaks down
bottom grid at 2.20

No 9 Blue start at top
at 222 pm -

3 pm put little Hydroxylamine Hydrochloride in No 3 & No 7 & No 1 - 1 & 3 were brown - Hydroxyl made them browner

3 pm No 6 W White -

No 8 very blue at 305 pm. Changed Solution & put some Hydroxylamine in it -

3 pm Changed No 9 to fresh Solution - it was tinted blue to still -

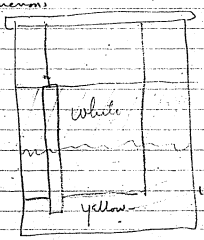
No 10 is Copper in bottle not
cleaned but ~~put in~~ 2 wash with
20% sol of soda & put in
grid not examined very strong
grid 3/4 full - but large quantity 30-40 ml
Hydrosulphuric put in solution
before starting =
Cop comes out grid some. at 9
put grid on reducing by mistake
On at 3.52 pm -
for some reason H from phosphorus
makes 1½ inch top of sol
a dense white cloud of bubbles
or something

~~No 8 going at 3.55 pm~~

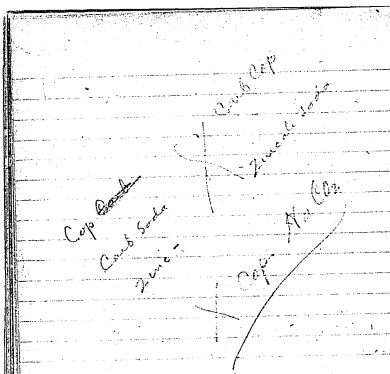
No 6 has blue tint faintly
Strong at 4 pm

at 4.10 pm fresh sol for No 9
with Hydroxylamine —
I put Hydrogen in cell 9 took
off & it turned blackish
showing that Blue may be
due to something else than Cu
possibly Nickel possibly pp Cu as
black oxide —
Its curious how white cloud of
H bubbles form at top when
Hydroxyl is put in —

Phenomena:



Same thing in No 10 only
shrink to red



Comes out a gooz across dead level with bottom of platina —

No 10 Cell grid went suddenly black, bright yellow shade. Come out further up grids than the lower one on line with plat

We impression is that Silver cannot be used — I notice when use hydroxylamine that yellow oxicates are seen in the Brown solution + Brown is probably due to action of Light + Hydroxylamine or hydroxylamine alone — The Silver is more conspicuous than the Copper —

1. No 11 Copper grid — Cop. put in fairly light — dropped in 20% Soda with Hydroxylamine — on 6.25 pm
.52

No 12 Same — one 6.25 pm
.52

6.30 pm No 3 gassing Ready —
put fresh Cobalum in at 6.33 pm
with some Hydroxylamine —
started Oxdy grid —

No 9 gassing 3.6 amp hours —

8.30. No 10 gassing

8-30 - No 3 clear but has
lot yellow hydroxyl precip.

No 6 not yet gassing 8.35 pm

No 6 has now 5 amp hours
so the best so far
I think

that it is due to soaking in the Silver solution for 1/2 hour permitting Silver to penetrate & this gives a lead. It seems be best to make a silver solution without any excess Key & use say 2 grms $AgNO_3$ dissolved exactly with just enough Key & then put it in 2 quarts of distilled water shake it once or twice with the Copper & let it stay all night in silver solution, this would permit it to penetrate. The grid of No 6 is very bright the a Ni grid. The solution is greenish but not blue or strong.

No 4 which has been reducing & changed to new cell with 1/3 of bulk Cab Sol + 2 Sol 20% sol NaOH, oxidizing now at 9 25 pm .56 amp,

10 pm No 4 perfect white

10 30 " " " .5 amp

25.

10.30 No 6 shows slight gassing
about 6 ampere hours
Best yet grid perfectly clean
This result is probably due to
letting Cop stay in silver solution
1/2 hour + use of dilute solution

I now reverse it and put new
solution in 1/4 Carb Soda +
3/4 20% NaOH. —
on at 10.40 pm 7 Feb
.5 ampere —
I remark the Soda Sol was warm

No 1 was gassing being reduced
at 10 pm — at 10.50 I
Reversed to Oxdzg on new solution
1/4 Carb Soda 3/4 20% NaOH
warm — .5 amp —

10.50 pm No 4 W White —

It looks as if Carb Soda stopped the Blue but I guess I will be disapointed —

No 5 Cell reduced & going put in new solution 1/4 Carb Soda 3/4 20% Nash — Warm Reversed to Oxdzg .5 amp at 11 pm Fri.

11 pm No 4 W W White —

No 9 Which has been going a long time Oxdz. I reversed to Reducing (Charge) cell to 1/4 Chb Na to 3/4 20% Nash Warm — .5 amp 1125 pm

12 Midnight No 4 W White
2 hours 35 minutes OK –

No 6 W White
No 1 "
9 "
5 "

By Comparison with Soda 9
find there is a decided blue
tint to 5 not so much on
4 –

No 6 being nearer to WW –
No 1 seems OK

However the tint of No 4
after running 2 h + 10 m is the
lightest yet –

On all night

3

8 30 AM - No 4 has a very dark tint as if there was a lot of black particles in suspension Some fluff bottom jar

No 3. Very deep blue & lot of yellow or copper red at bottom of jar. This had Hydroxylamine & it shows that that reagent precipitates OK but precip comes out of grid (1) I suppose salt dont penetrate & blue coming out from Hydramine & precips & this floats, also it shows that it needs much more Hydramine than I used to keep cell clear

No 1 has only faint blue tint ~~[illegible]~~

No 5 Somewhat blue not strong only tint - Very large deposit platina 1/16 dia none dropped down.

No 6 only a trace of tinge of blue = as 6 is reducing it shows that the blue forms notwithstanding Reducing But it may be liquid Eating platinum wire copper at top of cover + dropping down

No 8 Very blue

No 5 - clear tinted blue - weakly =

No 9 - W White

No 10 - only tinted by particles floating & think

.3 amp
Took Current off at 8.30 ace mp

on at 9.10 .55 - amp

No 4 I filtered & found that there is only a faint but well defined tint of green the darkness was mostly due to suspended particles & it may be even this tint comes from drops from Covers - put it back in the old solution 9/15.

No 1 grid gassing

- I notice a yellowish precip floats to top & goes around circumference of the jar at water line - very little of it but it shows on all hydroxyl assume also there is a white precip floats in layers & ultimately drops down. Evidently Carb Soda is a help of it will work with Zinc solutions -

It is possible that other things say Chl Na, KodK & may do something

The reason we do not get high efficiency from Cop precipt. by Zinc is that the silver does not cover every particle —
We took 80 grammes of Copper made by taking Cupric hydroxide drying it to about that turned it to anhydrous ox then put it in a big grid & produced by Current, we kept it going hours after reduction — Washed it well & squeezed in cloth, Weighted 80 grms there were small lumps in it that couldnt be got out by fingers —
Used 8 grms $AgNO_3$ with KCy to dissolve — then used 2 grmts
water let Cop stay all night in morning found on stirring that the interior of the smallest lump was still red & silvering was only on Exterior of lumps — Solution was blued — Lots silver left in Sol. as shown by HCl —
Evidently the Cop must be in an impalpable powder & have thrown into dilute Silver Solution & stirred for hours

think the finest Copper will be got from Carbonate Cop by Hydrogen the Carbonate We may have to prepare ourselves by precipitg + Carb Cop + drying + use of alcohol

1015 – Blue streamers Coming down from grid of No 6 –
I guess Carb soda isn't any better or but little better than regular 20% NaOH –
it shows however that it does no harm except to weaken the amoxent of soda –

I put some peroxide of Hydrogen in No 6 but it does not change Blue –

Saturday 11th Aug 1900

The results of the weeks experiments are this -

1. Finely divided Copper slightly silvered gives very much less blue.

2. The Blue is greater the less the surface or porosity -

3. Experiment shows that all our finely divided Copper was badly silvered

4th That Cop by Zinc or reduction of dehydrated hydroxide by Current is Lumpy - where there is a lump only the outside is silvered

5th That CuO is a non Conductor hence the whole of the ~~Cop~~ Cu should have a silvered backing as ~~reduction~~ ~~cod~~ Oxidation as is shown by a Copper plate may silvery to probably 1/10000 of inch

Copper reduced by hydrogen & heat from an extremely fine precipitate of some salt of Copper at in a base state is only way apparent now —

6th

7 th The Copper should be impalpable & when put in water take a long time to oxidize —

8th The Silver solution should be very dilute, Say with 100 grammes of Cop. Use 10 grammes nitrate silver & Key in Excess. Then dilute with say 4 or 5 gallons distilled water ~~should the water in 10 parts~~ ~~& Copper 10 parts~~

~~Dilute with solution of~~ ~~parts of Copper 5 parts~~

The work Copper in water stir & pour off from time to time the Dop that settles slowly when all fine Cop is poured off work balance with fresh until whole or all that can be used is in exceedingly fine state divide it roughly in 5 parts & then while stirring Silvering Solution pour to each Let in suddenly - stirring for say 5 minutes, do that for all & then set aside & stir occasionally

Over

August 13 1900

I now have some 1/2 width Nickel grids — I took some of the Copper reduced by Zinc & Strong it up in big battery jar & poured out the float Copper or Copper that didn't settle immediately — Washed this several times & then used Nitrate Silver & just precipitated & redissolved in the nitric acid any excess — only let stand about 5 minutes then washed it & did same thing again using another dose of silver — The resultant Copper is grey & flattening by rubbing shows no pieces not dissolved — ~~So~~ the whole is finely divided packed rather hard in grid & 1/2 inch asbestos packed in the top of grid to keep blue from floating out. As there was a great deal of silver left in the solution I think the next time I should let solution stay longer

or possibly used twice the strength
+ let it stay longer. However
this ought to give good results,

On at 6.10 .5 Amp

which is twice the density
used in previous Experiment

7.30. No blue, grid bright
Thin black coating on
platinum wire.

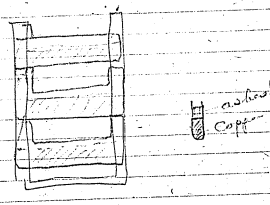
Gas at 8.30
Liquid appears blue when
compared with water
At 9.0 strong blue and
gives off the full amount
of gas
No copper dropped out
of grid.

1¼ Amp hour = ~25%

Reversed at 10.00 in fresh
Solution. — .3 Amp

Made a new cell No 2 A series

Thus has Cop by Zn fl coated + treated with AgCy with not Enough KCy to dissolve precip. Thus seems to work well — to put in new style grid rather loose asbestos sheet on top



The blue must go through asbestos + no Cop can fall out of it sometime dont have to be pressed hard

No 1 A

On at 9 am — ~~at start~~ it was fully reduced, .34 amperes

at 12 noon no signs of blue/.02 amp — not gassing —

at 12.05 started slight large blue over grid — off 12.05 pm

on 12.55 pm — .34

from 1.25 pm till 1.45 pm .15

from 1.45 .34 at 2 pm 1.2 amp hours

3 pm 1.54 amp hours

4 pm 1.88

5 pm 2.22 ~~tu~~ 5.30 Then gassing reverse

at 6.30 pm Reversed —

at 10.35 (changed solution it was quite green —

at 12.22 AM .34 Did Current down to .15 ~~for~~ the night

at 8.15 found it gassing started oxidizing lot. 8.20 AM —

at 9 shows blue at bottom under grid —

A2. Soaked in solution one hour
started Current 12.55 pm 14th
August 1900 — .34.
gassing all the time, has Ni
plate in solution, gas shows
no asbestos —
I reversed & reduced for few minutes
No gas then reversed and oxydized
2.10 pm Ox. .34 — no gas —
gassed at 5.15, called it gas
full 6.32. Reversed to —
gassing 7.50. Reversed to Ox. 02 at
8 o'clock. gassed 8.55 Reversed
to reducing

A3. loose Cop. 2.50 pm
.34 Thin ~~Ground~~ - with 20% Nitric
Dried it out Sand bath,
at 6.50. 204 amp hours
Tinted gum glue = large grained Zinc
at 7.50 2.38 amp hour
at 8.50 2.72 —
9.10 2.82 —
just started gassing slightly —

2.56
.34
2.9

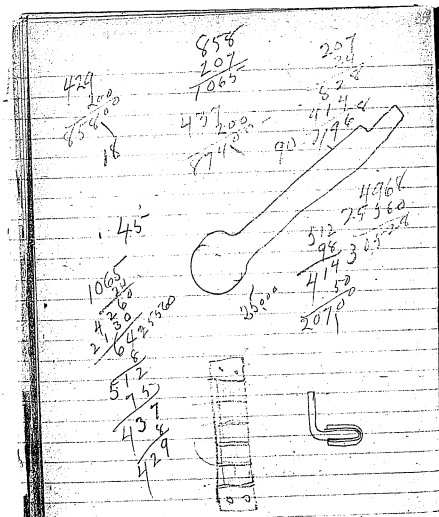
Changed Solution & Removed for
reducing 9 15 pm — .34 amps
& took grid out with idea of
pushing oxide down with Bamboo
but found it hard as a rock
washing would come out of grid
by washing — Evidently out
Removed the copper & found be
oxidized in loose manner & the
Silver oxide packed in grid
instead of the metal — We
or three powder mixed with Cop-
when pulling in grid — the Zinc
will eat away & thus give —
porosity

at 12.22 AM put current
down to .15 for
the night —
at 8.20 AM not gassing current now
.34

Double dose solution — 12 amp hour Mg

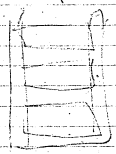
4A. This is Cop with more than
usual amount of silver ox-
double dose & washed with Bamboo
in glass in solution to break up
clots put in quart wet about all
water it will hold without showing
free water = tamped it very
slight — 3/4 full — may have
some pape fibre in it
det it Sank 10 minutes in Solution
to get soda in before pulling
Connection = —
On at 4 pm .34

at 6.30. .85 amp hour
at 7.30 1.19 " "
at 8.00 1.36 "
at 10 — 2.04 "
10.10 pm gassing —
Reduced to Red
Solution quite green — changed .34
10.35 pm —
at 12.22 AM put Current down
to .15 for the night
8.20 AM not gassing — Put current to .34
8.30 gassing — Removed 8.30 AM



5A ~~asbestos mixed with only~~
~~a little Copper oxide in and~~
~~asbestos powder — all went in~~
~~thin mush~~

No 6 -



Good

packed mostly to top of tube
with Copper Oxy powder
Cap with with 20% sol
did not pack it at all —

10:15 pm on 0x02 :34
11 pm very slight passing
at 11:08 pm started passing more freely
so I Released it :34
Note at :15 it did not pass — The
density is very great at :34
12 mgth passing Released at 12 mgth

174

175 drops

Good -

No 7 Copper in 20% Sol packed by
pouring in 1/2 ℔ lb qtd of
Dissent powder & comp. boxes -
Outside jar & Cover with asbestos
held in position by metal clips

10 38 pm .34 - 0.43 -

at 12.22 AM put Current at
.15 for the night

This has added to its real certain
that there is any blue in the Solution
at 8.20 put current to .34

2.78 amp hour at 11.30 -
scarcely a shade of blue left
3.29 amp hours at 2 pm 5.20 pm 4.44
blue tint extremely weak if any
3.8 amp hours at 3.38 pm
5.20 - on a bubble now & then Cover
out no blue whatever, I then at 9
wired reverse to Redey 5.20 pm .34
Raised to .5 at 7.40 pm
O.V.W

No 7

9.30. 24 grs tested blue
Picked. Advance brought blue
through to the Indicator & the
blast started in Acetic &
Ammonia mixed peas by Hydrogen
There is a little bad of pyrites
Copper. 21 Ores pretty good but
it did not only stop blue

There is a white cloud showed
bottom 3/4 high from there
Carts 0.82g of Reducing —

19
120
102
249

Mixed with Zinc — No 9

No 8 is 20 grains Cop 3 grains
Nit silver then charged &
mixed with 6 grains powdered
Zinc, squeezed in cloth &
then rammed hard in 1/2
inch grid, Charged 0.80g at
11.45 pm .34 —

at 12.22 AM put current to
down to .15 for the night
not going in Morning put current
at .34 at 8.20 AM —

There is a layer of blue at the
bottom because bottom of grid
has broken out,
changed cell at 9 o'clock —
9.30 No blue — 1.58 amp hours
No 8 going — Cell at 11.30,
2.49 amp at 11.30 —
as the blue continued going on
for hours I Reversed it to Reduce
at 4.15 pm .34

Raised to .5 at 7.40 pm
going 8.45 - Reversed to 0x2g 8.50
.15
0.82

Mixing Zinc powder to get
positive to Neg —
on oxy. Swamm blue came
down at bottom grid —

No 9

No 9 is same as No 8 except
has a Copper grid - wood same
material but 6th Copper
grids are square but
not as hard as No 8 —
started Oxy 12 22 AM
~~at 12~~ .15 amp

Not gassing in morning — at 8.20
put Current to .34 —

Blue in bottom of cell is
awful This apparently shows
that a Copper grid is not good
+ that Nickel is the only
satisfactory grid
Changed Electrolyte 11 am
old electrolyte which was very
oily & turbid on reversing generally
distributed Tiny bright globules
was black now clear
2 pm gassing + Zinc deposited
on Copper grid.
Reversed to Oxy at 2 pm .34
Raised to .5 at 7 40 pm

Note —

With Copper grids the Blue is removed long, it falls to the bottom and the only explanation is that Current attacks the grid in preference to the finely divided Copper from getting out of Contact or for some other reason — The Nickel grid polarizing same does not from being attacked, I shall try plating Nickel with platinum.

No 12 Same as No 8 Except was Copper —
Started 0x4g 12.22 am —
.15 amper.

Same as No. 9 —

" " " "
" " " Burned out (spoiled)

Guard 2 pm Reduced to 0x4g3
.34

Raised to .5 at 7.30 pm

No 4 (Continued), good amount of blue come out in flat layer near bottom of pri & probably towards that place — 1.66 amp assay, Reassay to Reduce! Oz 25 pm .34

Quicksand 7.30 — only 170 amp hours | This is no good

Evidently too much silver is no good its low its only 3/4 full (1/3 gold 6 oz) amp hours is so low — only thing about No 4 is that it has more silver than any other — so far tried perhaps I am wrong too much, in all the Experiments —

Reassay 15 at 740 pm

~~Gassing [illegible]~~

~~No gassing [illegible]~~

gassing slowly now has been gassing for 1/2 hour — Reassay at 8 to Oxdy

8' 3'

3/4 6 3/4 6 3/4 6

3/4 6

2.55 amphours

Loose Copper 3.06 amp-hrs

No 3 Continuing the cell is reducing & now shows deep brown color in ~~Sat~~ Solution — No blue at 920 gassing — I notice after Current is off the continuing gassing for several minutes

Reversed at 4.25 A into Oxygen

no blue at 2 pm — at least only a tinge of Cop —

1.19 amphour at 2 pm

2.09 amp hours at 4.30 pm

7.20 gassing 3.06 amphours

7.35 Reversed to reducing

Raised to 15 at 740 pm

No 1 A Continued

34 tests as of Hydrogen added to increase the flow of the cell goes on OXY circuit —

as it was on at 5.20 A.M. now going 0.30 ques 306 amphour

Recorded at 6.30 to reday 34

Raised to 15 at 1/40 pm

34
4
6
30
31

No 2 put on ~~Oxdg~~ Ready at 8.30 .125
.51 amp hours Returned to
Oxdg at 11.30. .125 amp
at 2.05 pm .15
gassing 2.50. Returned
to Ready 2.52. about .32 amp hr

Left out to recharge
Gas -

good Rest

No 6. put on ~~Oxdg~~ Ready at 8.30 .125 amp
~~at 11.30 .51 amp hrs~~
~~102 " at 2 pm~~
~~Discharge 11 hours~~
.56 amp hours at 2 pm
at 2.05 pm .15
.8 amp hrs at 3.30
started gassing slightly at 4.20;
.94 amp hours no time
given received to Oxdg at 4.30 pm
.15 amp at 4.20 .45 amp hrs
at 8.20 .6 amp hrs
9.20 .75 "
10.20 90.5
11 pm 1.04
11.20 1.09 gassing
quite strongly at 11
Returned to Ready at 11.20.

Not good

K05 Ni grid: Silvered Cop 6 by 2 in Reg
Sponge put in small porcelain
Crucible & heated 3 or 4 hours to
oxidize the Copper – it did it ok
didn't stick to Crucible = Instead
large number white specks in it
Evidently our Cop Silvered is
dirty with something – put the
Oxide on grid ran wash hand –
waved in Reg 20% & then put
it in Reg Cock Charged
953 AM – .34 –

2.04 amp hours at 5 o'clock pm –
2.37 " " 6.05 pm
gassing –
Reversed to 5 at 6.10 pm .34
Raised to .5 at 7.40 pm
gassing 92% K.G.

No good

No 11 - Reg Cop added some Hot to
[illegible] then silver in two parts
then washed, then grained in a gate
[illegible] finishing stick [illegible]
poured [illegible] [illegible]
[illegible] then [illegible]
Rag to clean the [illegible] Rag
[illegible] by [illegible] [illegible]
[illegible] then [illegible]
of Iguana [illegible] [illegible]
[illegible] of [illegible] in [illegible]
then [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible]
desk [illegible]
Let it soak one hour - on at
1.05 pm .34
Raised to .5 at 7.40 pm
gassing at 8.20 - (reversed) to Red
5.30 pm

No 9

No 12 Ni grid and gold Nickel
[illegible] 25 grms
Nickel sulph Zinc & Sulph Manganese
2 3.5 gm - oxd z - grid (well) with
Cake in 1/32 Cell placed
.34 —
Water gain Ni grid black deposit
of Peroxd Mang — These sticks to
bottom of cell Brown liquid
not a precip apparently although it
may be
Volts .5 — These along

No 9 —

13 Nickel Cond filled with black ox
Cop made by pouring few crystals
Citric Soda in Sulphate Sulph
Copper - Washed by decantation
then 8 ounces - ct/quarts
sufficient to fill cond
heated it for 1/2 hour in Evap
dish on which with to drive off
water So Na Sulphate cooled off

When I put it in Sol some
came out - ~~at 7 o'clock~~ 10
Measured on at 6.50 pm
~~Reading .34 amps~~
Raised to .5 at 7.40 pm

Something strange about this cell
8 10 I found it disconnected
the wires out - Perhaps I never
Connected it which I am sure
now as the Cope - been soaking
2 hours without Current on at
8 15 pm Reading .5 amp

Ng —

14 w dup of 13.
Check 16 packs and in Book —
on Reding 615 P & did not give the
a proximately look like 13.
~~on at~~ .34
Raised to .5 at 740 pm
1/2 amp hours at 10 pm

When reduced took it out & soaked
2 hours in water, then put it
in large beaker & put in about
3 oz water & cut, then put 1
gram Nitrate of KCy no excess
added & stuck for 5 minutes
and got beautiful deposit

I now put it back to see if I
can reduce it still further
Reding at 1145 .3 amp —
This grid I pressed down with
bamboo hard pick after
reducing as far as it would
& before I deposited it —
in 5 minutes it
goooo Ng

3 amp alcohol

Memo— The two best girls
had their lamps wet with
soda solution before packing
above packed I have the best
only partly immersed in —
The little girl with pocket lamp
immersed in alcohol & has
leaden, the solid has evaporated
& probably got all shaken —
Another due & Wed to
Blue gillies, cranberry, very
great specimen, and lots
pocket gifts at Lell
Bottom bl pocket lamp
& may also help to make
Cupid locket together or
something —

No 16 new small pocket grid
1/4 high 1 1/4 3/16 wide 1" long
5 of them –

Copper by Zinc – (Coated, washed)
then boiled or nearly boiled several
times with water + 5% HCl in it
then washed 2 or 3 times with hot
water only = Then Silvered by
dabbing on Key – Key till in 2 cups
ammonia in regular water, scrubbing
dab it on with a = then washed in
water several times grinding –
as ~~water~~ it got cleaner, it became
less clotted & rubbing & added 20%
Soda + ground it into an
Cloth entirely – so that it got to
the original fineness – took each
pocket + scoppe up nearly stop
till overfilled + then pounded till
it was 1/8 below top = after
all filled put them in mid
+ pounded them assembled This
Cover Cap – for a little 1/16
down from top of grids

put them in neg 20% NaOH at 1 o'clock pm .15

at 2 pm put Current to .30,

at 3.30 pm tried to raise density to .5 but it started gassing immediately so put it back to .13 When gassing stopped = 9 naked packets had yellow spots on them looked like raw meat when we put .5 + grid gassed. Yellow spots started to turn dark blood — 3.35 grid gassing at .3 somewhat Reversed to Rechg at 3.36 pm .3 Reversed back to Rechg at 3.42 pm .13 No gassing at 3.55 but 9 naked that the black spots which went colorless when 9 reversed 5 minutes are now starting to blacken

There was a very slight gassing — 9 reverse to Rechg at 4 pm for 5 minutes in 8 minutes gassed — 9 now reverse at 6 pm but was going to over Rechg at, so 9 think the Ni grid is not giving it there is want of Contact — Reversed Rechg at 4.13 pm .3

.30

3.35
.35

4.13
4.23
5.00

7.5
4.5 - 0
3
35.7

gassed at 5.25 – raised up some
of the Copper in 2 pockets
Reversed at 6.30 pm – .35
OxDg –

as Cop had very little Silver
on it look it out | cleaned
grid in Nitric, & made some
that had been worked by HCl –
then NH_3, then H_2SO_4 – got more
silver on it – used water, just
20% Nitric to put it on grid –
Cop is fluffy hence not much
on grid | reduced each pocket
& Chlor grid as usual | put it –
on Reduc for one min fully
was then 1 OxDg at 7.05 pm
1.32 –
gassed at 11.07 | 1.28 amp hours
Reversed to reducing at
11.07 pm – .15 Amp

Running all night
during the gassing, some of
the copper has been brown
out.

Turns blue after 1½ hours →

Reversed 8-17 at 8.15 am
Bysson at 3.30 – after .93 AH.
Reversed in hot soda
Bleached and dyeing before
10 o'clock in evening.
Cut out during night
Reversed for oxidizing at 8.10
am. Dry 18 – Dyeing at 11.30
Phosphin .52 AH.
Rather strong blue colour

17- Thin pocket grid dipped acid to clean - Cop coated with platinum by using Chloride platinic / looks black but under Microscope bright & clear every particle with polishing the Copper it appears Perfect -
on at 11.07 - 0x03 .15 amp

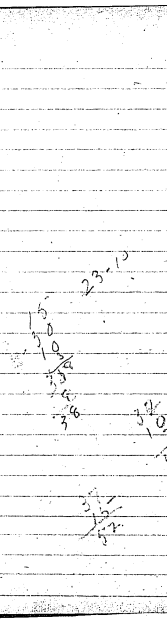
Running at 1 amp

Going 8-17 at 8.15 in the morning. Reversed at 8.15 during reducing the violet colour disappears, the platinum plating back
Goes at 2.35 p.m. .79 AM.
Reversed at 3.30
This time less colour
Forms going at 10 pm.

Reversed for reducing at 8.10
going at 11 (0.45 AM)

A098 = 4 pocket light grid —
dry pocket weighed .8 grams before
filling 1.15 after filling —
filled with Copper Silver
amalgam 1 to 10 silver to Copper
distilled off Hg in tube & pouring
H hydrogen stuff not evenly
distributed apparently a pretty
uniform apparently = VERY porous
Total in grid 1.4 grams —
This was made by Ruffin

On O2dg at 11.10 AM .15 amp
it almost immediately graded
reversed to reducing at 11.11 AM —
at 1113 graded on Reducing & left
grid till 1120 then reversed to O2dg
2.15 Reducing .15 graded at
2.52 Reversed to O2dg at
2.52 pm .15
O2dg at 6.50 pm .15
graded some at 8.17 — Reversed
at 8.18 to Reducing graded 7.955
Ng —



No 19 = Nitrate silver + Nitrate Copper Evap to dryness + redissolve by Hydrogen = very light but almost uniformly silver Sol'n distributed .122 grm in each grid 4 grids or pockets .88 grm acc (positive =
~~on Oxdg at 11.10 AM .15 amp~~
Redcg 2.15 pm .15
Gassing 3.55 pm = reversed to Oxdg
at 7.15 .50 amp gassing slightly
at 6.46 but not violent = almost
gas'd freely at 2.15 Reversed to
Reducing at 8.17 .16
reversed 12.15 — Reversed to Oxdg
at 12.15 + Look Current off
for the night —
On 8.35 AM .15
at 11.10 am gassing slightly
.38 amp
Reversed to Redcg 11.23 AM =
Current off 17.15
on at 1.07 pm gassing 320
.45 amp hour Rev'd to Oxdg
at 3.22 pm at 4.44 not
gassing 1.10 at 4.34 quit current
to .15 at 8.16 gassing slightly
.58 amp hour Reversed Redcg 8.20 pm .15

20 – Reg Cap by Time Marked
[illegible]
2.15 pm – .15 0203 –
[illegible]
[illegible] 55
[illegible]
9. reversed d-to Returning at 4.42pm
.15 [illegible] 740 [illegible]
[illegible] 142 [illegible]
1203 – [illegible] staff [illegible]
[illegible]
[illegible]

21= Nickel Cap 50 Nickel Nickel
15 = Sunnyside Co dropped returning
Flow in tube greatness by Hydrogen
hot - took brightest - packed fairly
hard
on 226 pm Reduing - .15
gassing 235 pm Reversed to: Oxdg
2 36 pm .15
gassing at 740 pm Revsd to
Redg at 740
.75 amp hour Black flow in good
gassing at 1117 = Reversed to
Oxdg 1117 = .53 of
amp hour = Current .15 Flow =
Current Taken off to
Flow right at 1215 AM
on 8 35 AM .15 gassing
slightly .53 -
Reversed to Redg 1122 am
Current off 1215
on at 1 0
gassing 320 - .145 amp - Revsd to
Oxdg 323 pm
at 445 pm put Current back to .14
at 437 put Current to .14
Redg gassing at 810 pm - Rev to Redg 810 pm
.15 .52 Amp

[illegible]
[illegible] Well [illegible] Co - together
[illegible] Dropped them by Hydrogen
heat of on, Oxdg - 415 pm - .15
[illegible] [illegible]
[illegible] Blowing [illegible]
7.47 pm .15 gassing 117.
about .52 amp hour
Reversed 117 pm Oxdg .15
[illegible] Blowing [illegible] at 12.15
[illegible] the weight on 5.35 AM
.157 at 1.30 [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
at 11.36 AM .15
[illegible] 12.15.
on at 1.07 pm
gassing at 3.50 pm. Reversed Oxdg
at 3.52 pm.
.51 amp hour [illegible]
[illegible] at 7.30 [illegible]
.15

2.4
15
45
45
8.4

2
3
45

3 - Copper by Zn + sponge accelerated
nickel deposit with & after sponge
Copper - Prepared by Hydrogen bubbles
used only the light - yellow sponge
heads - Is quite tough stuff -
Shows no signs of blistering -
On ord at 8.30 am 115 -
Current taken at 27 - 30 Amp
on the mill on 8.35 am 115
opening 9 am - Resumed to
stabilizing at 9 am 115
Opening at 11.50 - Resumed to
Ord at 11.52 AM 115 no current
Coloured off 11.55
On at 1.07 pm
shell
at 1.45 pm
10 at 4 pm
at 1.47 pm

780

33.

300

105

218

2240 | 6300 (218
4480
4200
1820

218
8
224

28
7
196

14
80 (70
112 (80
16 | 112
4200

2240 | 4200 (1.8
2240
1960
1792
168

24 = Cattleman [illegible]
[illegible]
[illegible] 10 [illegible]
all [illegible]

709

24= This is the [illegible]
Copper [illegible] with [illegible] Nickel
in Hydrogen [illegible] tube with heat,
packed in light —
On Reducing at 9 15 am .15
at 9 34 gassing, silver [illegible] one of the
stuff was oxidized [illegible]
is 0x039 9 30 am .15
4 grids each had .410 milligrams [illegible]
Current off 12 15
on 1 07 pm
[illegible] at 1 50 pm .58 amp
[illegible]
[illegible] at 1 55 pm .16
at 445 pm put Current down to
.10 gassing 5 35 Reversed to
0x039 5 37 .52 amp hour
at 7 37
This cell has the least blue tint of
any cell from 19 to 28 inclusive —
The grid is also the only one that is clean
when the regular Nickel color
is so blue that it is doubtful if there
is any gassing [illegible] 11 10 pm
.73 Amp at 11 10 [illegible]
60.6% efficiency No blue perceptible
9 put current at .10 for the night at 12 45 am

41.9
1.640

1.60
.16
1.44

20
4.5
7.3

1.35

3.3

20
4.8
7.3

Big piece Amalgm-
placed 110 pm - Reversed
O&Dq at 112 pm

30°
30°
45°

[illegible] Bridge only [illegible] [illegible]
[illegible] put [illegible]
[illegible] O&Dq 12.12 Reversed
.16
Current [illegible]
on 107 pm
[illegible] 412 pm
[illegible] at 737 put Current
to .15
Amalg 425 pm - Reversed 625 to O&Dq
.15 at 1125 .15 amp
at 12 Midnight .153 1230 .015
at 1245 just above angle of
gassing - Making .64 amp hour
9 reversals to replating at put
Current at .10 for the night at
1245

26 – Amalgam – 2 grms Nat Silver
20 grms Clap by Zinc – grid full
of amalgam filled by hydrogen
in tube by heat swelled, pocket
should only be 2/3 full of
Cut away extra that overflowed
by knife. Weight of slip on
of grid 1.98 grms
put on Oxdg at 3 27 pm –

at 4 pm

at 7 37 pm put current to .15
gash 8 40 pm Removed to [illegible]
.15 10 smelly gassed – reversed
to Oxdg at 10 35 pm .15

4.5

72 | 4692 | 16
432
48

16
45
28
40
0
21

480 grms 4/3.6 sacks

9

3.6 to lb 9

16

24

3 2

1" 5 yr 16 thick

cutter

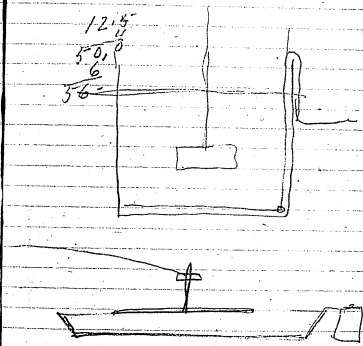
6.25 125

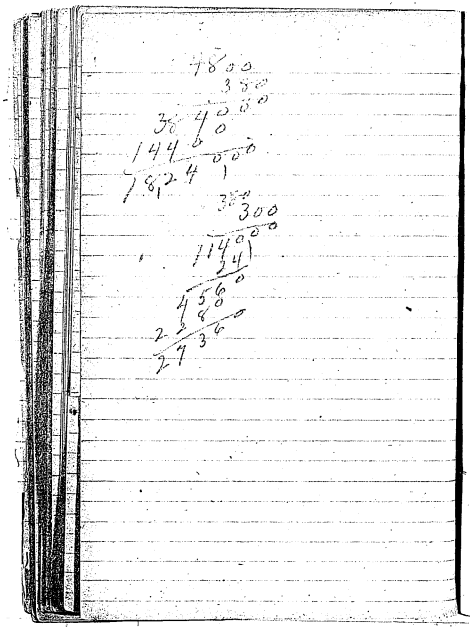
12.5

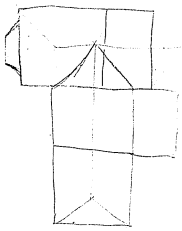
50.0

6

36







72
21
72
144
1512

34
21
34
108
1134

44
11
484

1134
484

144 | 3130 (22
288
230
216
14

5.95

9.50
6.50
6.50
3.80

17
34
51
50
32
82 | 320 | 39.
268
7

1387.46
61
28

12
85
60
96
102

325
85
1625
2600
27625

Fe 64.68
S 0.109
P .049
TiO_2 — 1.382
Ti — .846

1387
61
387
32
355